DOCUMENT RESUME

ED 244 475 EC 162 494

AUTHOR Mathinos, Debra A.; Leonard, Ann Scheier
TITLE A Comparison of Two Instructional Methods for Teaching Logo to Learning Disabled and Nonlearning Disabled Children.
PUB DATE Apr 83
NOTE 13p.
PUB TYPE Reports - Research/Technical (143)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Computer Software; Elementary Secondary Education; Intermediate Grades; *Learning Disabilities; *Learning Processes; *Programing Languages; *Sequential Learning; Student Characteristics; Teaching Methods
IDENTIFIERS LOGO Programing Language; Programing Language

ABSTRACT

The study examines the use of LOGO, a computer language, with 19 learning disabled (LD) and 19 non-LD students in grades 4-6. Ss were randomly assigned to one of two instructional groups: sequential or whole-task, each with 10 LD and 10 non-LD students. The sequential method features a carefully ordered plan for teaching LOGO commands; the whole-task method is an approach presenting task-specific questions within the context of social interaction. Analysis of scores on teacher rating scales, observations of learning strategies and of social interactions revealed a higher average mastery score for the non-LD than the LD Ss. LD Ss appeared to benefit more from a whole task approach whereas the non-LD Ss earned higher scores when they received sequential instruction. Possible explanations for the findings, which conflict with current instructional practices for both LD and non-LD children, are offered. (CL)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
This document has been reproduced as received from the person or organization originating it.
Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

ED244475

A COMPARISON OF TWO INSTRUCTIONAL METHODS FOR TEACHING LOGO TO LEARNING DISABLED AND NONLEARNING DISABLED CHILDREN

Debra A. Mathinos

Ann Scheier Leonard*

University of Rochester

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
Ann Leonard
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

*This paper is based on the second author's doctoral research.

EC163494

Recently, educators have begun to explore the use of computer technology in the classroom. Computers have been used for numerous purposes including: the development and reinforcement of academic skills; teaching computer programming; and the development of problem solving skills (Shiffman et al, 1982). While a variety of computer languages have been employed in educational settings to satisfy these purposes, one language in particular has become increasingly popular among educators.

Logo, initially designed at the Artificial Intelligence Laboratory at the Massachusetts Institute of Technology, is reported to create a learning environment in which children and adults are able to: explore such content areas as geometry and physics; learn the logical structure of programming; and develop and utilize a wide variety of learning strategies necessary for the enhancement of problem solving skills. During the past decade, this language has been introduced to children of various ages and with wide-ranging abilities in both educational and research settings. A review of literature reveals Logo projects involving young children aged 3-9 years (Overall et al, 1981), learning disabled students of various ages (eg. Watt, 1982; Weir and Watt, 1981), and physically handicapped children (Watt, 1982). In addition, Weir et al (1982) report that the MIT Logo Group has worked with autistic and other emotionally disordered children as well as with children with dyslexia.

Conclusions drawn from these projects are, as a whole, extremely positive, with improvements in problem solving, affect and knowledge of subject matter consistently cited across studies. Two additional findings concern the manner in which Logo is taught to individuals. First, these projects have identified student-student and student-teacher interactions as

critical elements in learning Logo. A related belief among researchers is that there is a need for teacher training as well as appropriate instructional materials for use by students and teachers. It is this second concluson that highlights a weakness in the research thus far. Lack of a consistent method for presenting this language to subjects limits the information that can be derived from these reports. This is especially true for information addressing the influence of exposure to Logo on an individual's learning strategies and problem solving abilities.

A second factor severely restricting the results of these studies is the manner in which investigators have collected and reported their findings. While valuable and often insightful information can be obtained from case history reports, reliance on this method to the exclusion of others has narrowed the amount of knowledge currently held regarding the effects of Logo on learning. As it is becoming increasingly apparent that educators will continue to use Logo with students of varying abilities, additional information concerning its capabilities must be obtained.

The purpose of this study was to examine some key questions surrounding the utilization of Logo with learning disabled (LD) and nonlearning disabled (NLD) children. Specifically, the questions addressed were:

> Will there be any difference in the mastery of basic Logo commands for subjects who are LD and NLD when exposed to Logo by alternative instructional methods?
>
> Will there be differences in learning strategies used by subjects engaged in Logo as a function of their classification and exposure to a specific instructional method?
>
> Will there be differences in the interactions among subjects and instructors while the subjects are engaged in Logo as a function of their classification and exposure to a specific instructional method?

Subjects

The sample consisted of 40 children enrolled in grades 4, 5 and 6 in a

large upper-middle income suburban school district. One half of the subjects were selected from the district's learning disabilities program, while the remaining subjects were chosen from regular elementary classrooms. All participating subjects were performing minimally at a 2.0 grade level in reading as determined by district wide testing that had occurred at the start of the 1982-1983 academic year. This minimum acceptable reading level was due to the analyzed reading level of the Logo materials as determined by the Fry Readability Analysis (Fry, 1968). LD and NLD subjects were matched for sex and age (± 3 months). The LD subjects were identified as such based on the criteria contained in the New York State Education Department Regulations, Chapter 11, Part 200 (1980). The NLD subjects had no prior history of learning difficulties and were not receiving support services at the time of the study.

The 40 subjects were randomly assigned to one of two instructional groups: Sequential or Whole Task, so that each group consisted of 10 LD and 10 NLD subjects. To facilitate scheduling, both instructional groups were divided into 4 sections of 5 subjects each, resulting in a total of 8 sub-groups. Prior to the onset of instruction, one subject from each instructional group was forced to withdraw from the study due to illness, thus reducing the total sample size to 38.

Instruments

Teacher Rating Scale This instrument was designed to determine the teachers' perceptions of their students' learning strategies. Following the format developed by Harter (1979), the scale consists of 16 dual ended statements concerning specific learning strategies. For each statement, one portion implies the presence of the specific strategy, while the remaining portion indicates its absence. After determining which portion of the statement best describes a student, the teacher further decides the extent to which the chosen section is true for the student. For 8 items the opening section describes the presence of the learning strategy. The remaining 8 items present the absence of the strategy in the initial section. A sample item is as

follows:

Really True	Somewhat True			Somewhat True	Really True
O	O	Some students are able to analyze a problem into separate parts.	BUT Other students have difficulty analyzing separate parts of a problem.	O	O

Randomization of items resulted in no two consecutive statements describing the same learning strategy. Directions for administration and scoring were those utilized by Harter.

Learning Strategies Observation Designed to determine the strategies an individual employs in solving a problem, this instrument consists of twelve specific strategies. Selection of the strategies for inclusion in the instrument was based on a review of the literature addressing metacognition and metacognitive variables (eg. Flavell, 1976; Brown and DeLoache, 1978). The strategies are: identification of the problem; identification of the parts of the problem; analysis of commands; gathering information - materials; gathering information - people; devising a plan; choosing the "best" plan; executing the plan; attending to feedback; revising the plan; evaluating the results; and off-task behavior. These strategies were scored as being exhibited in one of four communicative modes: verbal (V); written (W); gestural (G); or typed (T), or as assumed (A) on the basis of a series of overt behaviors. Observers made frequency counts of each subject's behaviors on a time sampling schedule of 3 minutes/subject, resulting in 2 observations for each subject per session. Prior to data collection, interrater reliability was determined to be 97.8% for full observation score and 86.7% for each learning strategy category.

Interaction Observation The social interactions which occurred among subjects and instructors were recorded in an effort to examine the kinds of information exchanged, and the nature of this exchange. The eleven categories are : (Teacher to Student) - prompt, management, statement, direction; (Student to Teacher) - question, clarification, statement, nonfunctional; (Student to Student) - question, statement, nonfunctional. The time sampling schedule employed with this instrument was the same as that used for the Learning Strategies Observation. Prior to data collection, interrater reliability was determined to be 96.5% for full observation score and 90.3% for each interaction category.

Logo Mastery A set of three figures of increasing complexity were designed to evaluate subject mastery of basic Logo commands following instruction. Complexity of a figure was determined by the number of sides and variations of angles within its design. During Session 11 of the instructional sequence, subjects were presented with these shapes and instructed to reproduce them on their computers. The subjects were also told to record the commands used in this reproduction on their worksheet. Mastery is based on the number of different commands used in the reproduction, with the greatest value being 8 points /shape.

The figures are assessed on four additional dimensions: placement of the figure; accuracy of the design; judgement of dimensions; and use of self-correction. As a result, the maximum obtainable score is 12 points/shape. The criteria for determining mastery was a minimum score of 4 points for any one figure.

Instructional Methods

The program of Logo instruction was devised by a task analysis of the skills required to produce Logo designs. The result was a hierarchy of Logo commands presented in the following order : FORWARD; BACK; Turning LEFT and RIGHT; PENUP and PENDOWN; Procedures; REPEAT. Each command constitutes a maximum of two 45 minute sessions of instruction. Each unit draws on information presented in previous units.

Sequential Method The sequential method provides a carefully ordered plan in which Logo commands are taught. Each unit is composed of an example of the command being learned, an opportunity for the subject to practice the command, and 5 figures that are to be completed by using the specific command. Subjects were also given time at the end of each session for exploration. The program materials include a sequenced interactive computer program, corresponding worksheets, and a package of 5 "degree shapes". Degree shapes represent 30, 45, 60, 90, and 120 degree angles and were designed to assist subjects in deciding the amount of turn necessary for figure completion.

Whole Task Method The process of internalization posited by Vygotsky (1978) was the basis for the presentation format utilized in this method. In this approach, task-specific questions were used within the context of social interaction in order to focus on the strategies needed for completion of the task designated for each session. As a result, the goal for each session consists of the construction of a figure which is presented as the vehicle by which a command is introduced. The order for command presentation parallels that of the sequential method. Whereas the sequential method involves completion of 5 predetermined figures, the whole task method consists of reproduction of 3 figures. These figures however, are identical to those presented in the sequential approach. Program materials include an interactive computer program, corresponding worksheets, and a package of 5 degree shapes.

Hardware

The configuration of the hardware used in this study was: Apple II+ microcomputer with 16K extra memory to accomodate the Logo language; 1 disk drive; and 1 computer monitor.

Procedure

Prior to the onset of Logo instruction, classroom teachers completed a Teacher Rating Scale for each of their students participating in the study. All subjects received 10 consecutive sessions of Logo instruction differing only in instructional approach. Each session was 45 minutes in length and consisted of a presentation of a specific Logo command, predetermined activities designed to expose the subjects to the command, and free time for design exploration. Exploratory figures were saved on diskettes as documentation of subject progress during the program. Instruction was provided by the two investigators in a manner consistent with the nature of the specific instructional method.

Observations of learning strategies and interactions were made during sessions 2, 6 and 9. These observations were carried out by two graduate students unfamiliar with the questions being investigated. Mastery of Logo was assessed during an eleventh 45 minute session. Allcommands employed by subjects in the Mastery session, as well as the resulting figures, were recorded on paper for later analysis. Although no direct instruction occurred during this session, subjects experiencing difficulties were prompted by the instructors when necessary. A final observation of learning strategies and social interactions was made during this session.

Results

A two-way ANOVA was used to determine the overall effectiveness of instructional method by group on Logo mastery. Significant main effects were found for group and the interaction of group and instructional method. (See Table 1) A comparison of group means revealed a higher average mastery score for the NLD group ($\bar{X}$=17.98) than for the LD group ($\bar{X}$=14.45). When

determined in terms of both group and instructional method, the following means were found: NLD Sequential ($\bar{X}$=19.22); NLD Whole Task ($\bar{X}$=16.75); LD Whole Task ($\bar{X}$=16.00); and LD Sequential ($\bar{X}$=12.89).

Differences in learning strategies as a function of group, instructional method, and the interaction of group, method and learning strategies were determined by a three-way ANOVA. Significant main effects were found for instructional method and learning strategies. Additionally, two interaction effects were found to be significant: group by learning strategy and method by learning strategy. (See Table 1) A comparison of subject means revealed greater observed strategies for the Whole Task group ($\bar{X}$=18.72) than for the Sequential group ($\bar{X}$=15.18).

A three-way ANOVA was employed to examine differences in social interactions as a function of group, instructional method, and the interaction of group, method and social interactions. Two main effect differences were found to be significant: group and social interactions. The interaction effects found to be significant were social interaction by instructional method (Whole Task) and social interaction by group. (See Table 1) A comparison of group means indicated that LD subjects engaged in more social interactions ($\bar{X}$=13.92) than did NLD subjects ($\bar{X}$=7.78).

Table 1

Two-Way ANOVA Summary Table for Logo Mastery

Factor	SS	df	MS	F
Group(A)	118.460	1	118.460	8.086**
Treatment(B)	.932	1	.932	.064
A x B	73.539	1	73.539	5.020*
Error	498.081	34	14.649	
Total	691.012	37		

Table 1 (cont.)

Three-Way ANOVA Summary Table for Learning Strategies

Factor	SS	df	MS	F
Group(A)	269.549	1	269.549	.973*
Treatment(B)	1387.479	1	1387.479	5.016
Learn. Strat.(C)	114539.698	11	10412.700	275.097***
A x B	160.437	1	160.437	.580
A x C	6867.533	11	624.321	16.494***
B x C	1225.603	11	111.418	2.944***
A x B x C	300.505	11	27.319	.722
Error	14156.304	374	37.851	
Total	138907.108	421		

Three-Way ANOVA Summary Table for Social Interactions

Factor	SS	df	MS	F
Group(A)	4595.859	1	4595.859	38.750***
Treatment(B)	247.438	1	247.438	2.086
Social Interact.(C)	80546.721	10	8054.672	220.959***
A x B	189.356	1	189.356	1.597
A x C	7758.108	10	775.811	21.282***
B x C	739.898	10	73.990	2.030
A x B x C	420.127	10	42.013	1.153
Error	12394.109	340	36.453	
Total	106891.616	383		

*p<.05
**p<.01
***p<.001

Discussion

While all subjects achieved mastery of basic Logo commands, it is not surprising that the results identify the NLD group as receiving higher average mastery scores than the LD group. However, the data analysis presented the picture of a disordinal interaction for instructional method and group that was unexpected. LD subjects appeared to benefit most from a Whole Task approach, whereas the NLD subjects earned higher scores when they had received Sequential instruction. These findings conflict with current instructional practices used to teach both LD and NLD children.

Although a wide variety of methods are being used with these groups of children, it is typically those approaches which are holistic in nature that are associated with teaching the NLD. Conversely, instruction based on carefully sequenced concept presentation; coupled with immediate feedback and reinforcement, is most frequently associated with LD children. It is possible that for the LD subjects in the Sequential approach the presentation of isolated components of the Logo language resulted in their lesser ability to integrate this new knowledge. Thus resulting in a decreased ability to apply this knowledge to different and more challenging tasks; ie. the complete reproduction of a figure. While NLD children are reported to perform such integrations independently, LD children are not (Reid and Hresko, 1981).

It is possible then that the Whole Task method appeared more effective for the LD sample due to the contextual manner in which Logo was taught. Also, the social interaction that is a major component of the Whole Task method may have generally aided these children in learning new information more readily (eg. Vygotsky, 1978).

Analysis of learning strategies data indicated that both LD and NLD subjects exhibited more learning strategies when involved with Whole Task instruction as opposed to the Sequential method. Due to the requirements of the Whole Task approach, such a finding is to be expected. Subjects in this approach reproduced entire figures which entailed the use of numerous commands; and hence, a wide variety of learning strategies. When compared to the requirements of the Sequential approach; ie. the completion of a figure by way of one or two commands and limited strategies, the abundance of learning stratgies for the Whole Task group is understandable. It is also apparent from the data analysis that NLD subjects exhibited a greater number of learning strategies than their LD counterparts. This finding is

supportd by learning disabilities litrature which suggests that LD children are less proficient users of learning strategies than NLD children (eg. Torgeson, 1980).

An interpretation of he results concening social interactions is readily available if one considers the nature of LD children as well as the characteristics of the Whole Task method. Data analysis indicated that social interactions were more frequent for the LD subjects than for the NLD group. Such a finding may indicate a greater need for teacher intervention on the part of the LD group, or perhaps may be indicative of more numerous attempts on the part of the LD subjects to obtain information and/or support during task completion. Literature concerning the social interactions of LD children supports both suppositions (eg. Bryan and Bryan, 1978). In terms of differences found between instructional methods, the very nature of the whole task method presupposes the existence of frequent social interactions. Thus, it was anticipated that subjects receiving Whole Task instruction would exhibit numerous social interactions.

It appears that some additional information concerning the three questions investigated by this study has been obtained. It is importnat to note however, that the limited size of the sample and short instructional phase preclude all but the most tenuous of conclusions. Additionally, the instruments used in this study may lack the sensitivity necessary to identify all but major differences among groups and instructional methods. Finally, it is quite possible that factors other than those investigated by this study may have produced or inhibited effects that were not considered.

As a result of these limitations, future research should focus on refining the instruments used in this study so they may become more sensitive to the influence of exposure to Logo on an individual's learning. Also, learning strategies and social interactions should be investigated

over the course of instruction to determine if changes occur in these behaviors as a result of exposure to Logo. Finally, a replication of this study with a larger sample could provide additional information concerning the educational capabilities of Logo.

References

Brown, A. and DeLoache, J: Skills, plans and self-regulation. In R. Siegler (ed.) Children's Thinking: What Develops? Hillsdale, NJ: Erlbaum Associates, 1978.

Bryan, T. and Bryan, J. Understanding Learning Disabilities. Sherman Oaks, CA: Alfred Publishing Company, Inc., 1978.

Flavell, J. Metacognitive aspects of problem solving. In L. B. Resnick (ed.) The Nature of Intelligence. Hillsdale, NJ: Erlbaum Associates, 1976.

Fry, E. A readability formula that saves time. Journal of Reading, 1968, 11, 513-516; 575-581.

Harter, S. Perceived Competence Scale for Children. University of Denver (Colorado Seminary), 1979.

New York State Education Department Commisioner's Regulations. Chapter 11, Part 200, 1980.

Overall, T., Lola, P., McKool-DaFoe, M. and Housey, J. Learning with Logo at the Lamplighter school. Microcomputing, 1981, 42-47.

Reid, D. and Hresko, W. A Cognitive Approach to Learning Disabilities. New York: McGraw-Hill, 1981.

Schiffman, G., Tobin, D. and Buchanan, B. Microcomputer instruction for the learning disabled. Journal of Learning Disabilities, 1982, 15(9), 557-559.

Torgeson, J. Conceptual and educational implications of the use of efficient task strategies by learning disabled children. Journal of Learning Disabilities, 1980, 13(7), 19-26.

Vygotsky, L. Mind in Society. Cambridge: Harvard University Press, 1978.

Watt, D. Logo in the schools. Byte, 1982, 116-134.

Weir, S., Russell, S. and Valente, J. Logo: an approach to educating disabled children. Byte, 1982, 7(9), 342-360.

Weir, S. and Watt, D. Logo: a computer environment for learning disabled students. The Computing Teacher, 1981, 8(5), 11-17.